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(11) Publication number:

0 568 764 A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 93100691.0

(51) Int. Cl.⁵: **B60R 21/20, B60R 16/00**

(22) Date of filing: 19.01.93

(30) Priority: 29.04.92 US 875390

(43) Date of publication of application:
10.11.93 Bulletin 93/45

(84) Designated Contracting States:
DE ES FR GB IT NL

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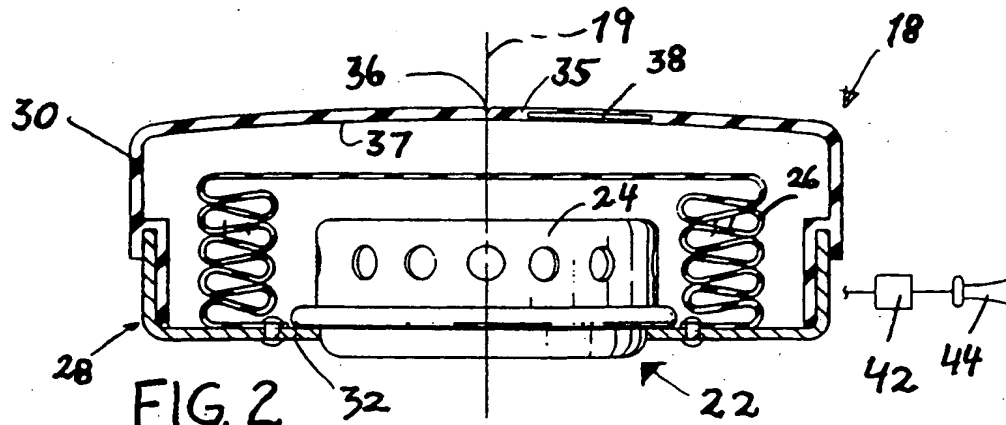
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(54) **A horn actuator incorporating a transducer in a steering wheel.**

(57) A steering wheel (12) incorporates an air bag unit (22). The air bag unit has a cover door (30) with a transducer (38) molded in a deformable front wall (35) of the cover door. The transducer is operably connected to an electrical circuit (42) that actuates a

horn (44) when the circuit senses an actuating output voltage at the output lead (41) of the transducer (38). The transducer produces the actuating output voltage when hand pressure is exerted on the front wall (35).



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Technical Field

This invention relates to a steering wheel incorporating a horn actuator within an air bag unit.

Background of the Invention

Steering wheels because of their convenient location have often incorporated switches that actuate various motor vehicle accessories such as speed controls or horns. Steering wheels are also the most convenient location for mounting a driver side air bag. The air bag is often mounted at the hub of the steering wheel.

The incorporation of air bag units within a steering wheel have made the inclusion of horn or other actuating switches within the steering wheel more complicated. Firstly, the air bag unit with its casing and cover door occupy a significant portion of the area within the steering wheel rim. Secondly, the cover door must be free from separately mounted accessories that may otherwise turn into potentially harmful flying projectiles upon deployment of the air bag unit and the forceful opening of the cover door.

Consequently, the horn switch which has traditionally been a relatively large centrally located button at the hub of the steering wheel has been relocated away from the hub and downsized to fit within the remaining space within the rim about the air bag cover door. However, due to the historically conventional practice of locating a horn switch at the hub of a steering wheel, most drivers still feel more comfortable with a horn switch at the hub, particularly when faced with a panic situation. The conspicuous presence of a large pad at the hub further confuses drivers into mistakenly believing that the pad is the horn button.

What is needed is a steering wheel having an actuator switch incorporated within the air bag cover door at the hub of the steering wheel.

SUMMARY OF THE DISCLOSURE

In accordance with one aspect of the invention, a steering wheel for a motor vehicle includes an air bag unit having a gas generator within a casing. An air bag is operably affixed to the casing for receiving gas from said gas generator. A cover door is mounted over the air bag for concealing the air bag during its stored inactive state. The cover door has a front wall section made from a deformable material.

A thin film transducer is mounted to or within the front wall section and normally produces a first non-actuating output voltage. The transducer is constructed to undergo the same deformation as the front wall section and is electrically responsive

to the deformation due to hand pressure exerted on the deformable front wall section for producing a second actuating voltage. The transducer is operably connected to an electrical circuit that is in turn operably connected to an electrical device such as a horn. The electrical device is actuated by said electrical circuit when said transducer produces said second actuating voltage.

In one embodiment, the transducer is a force sensitive variable resistor that has its resistance change upon pressure exerted on the deformable wall section. The change of resistance changes the resistor's output voltage. In another embodiment, the transducer is in the form of a piezoelectrical device which transforms mechanical pressure exerted on the deformable front section into an output voltage that is transmitted to said electrical circuit.

A broader aspect of the invention relates a thin film transducer mounted in proximity to a hub of a steering wheel and mounted to a deformable surface. The transducer, which can be in the form of a force sensitive variable resistor or a piezoelectrical device, is sensitive to pressure placed upon the deformable surface to produce an actuating voltage which is transmitted to an actuating electrical circuit that in turn is operably connected to an electrical device such as a horn.

In this fashion, the electrical circuit and electrical device may be mounted remote from the steering wheel. Furthermore, the transducer or its leads are not separable from the door upon any severe or sudden impacts. The deformable front wall section maintains its ability to function as a cover door for an air bag unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference now is made to the accompanying drawings in which:

Figure 1 is a perspective view of a motor vehicle dashboard incorporating a steering wheel in accordance with the invention;

Figure 2 is a partially schematic and cross-sectional view taken along lines 2-2 shown in figure 1;

Figure 3 is a rear perspective and partially segmented view of the cover door with the molded-in thin film variable resistor shown;

Figure 4 is a view similar to figure 3 illustrating a piezoelectrical thin film device molded therein;

Figure 5 is a view similar to Figure 3 illustrating another embodiment;

Figure 6 is a cross-sectional view taken along lines 6-6 shown in Figure 5; and

Figure 7 is a front perspective view illustrating another embodiment in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in figure 1, a motor vehicle dashboard 10 includes a steering wheel 12 mounted at the upper end of a steering column 14. The steering wheel 12 has a rim 16 attached to a hub section 18 via a plurality of spokes 20. The hub 18 is mounted at the central axis 19 of the steering column 14. As shown in figure 2, the hub section 18 incorporates an air bag unit 22 with a gas generator 24 and an air bag 26 operably connected about the gas generator to receive any gas emanating from the generator. The gas generator 24 and air bag 26 are mounted inside a casing 28. The casing 28 includes a bottom half 32 and a cover door 30 that is mounted to the bottom half 32 and is normally closed to conceal the casing bottom half 32, gas generator 24 and air bag 26.

The cover door 30 is molded from semi-flexible TPE, TPO or similar plastic material. The door 30 includes a deformable front wall section 35 that has a conventional tear seam 36 which provides the door 30 to open upon deployment of the air bag unit 22.

The door 30 also includes a force sensitive variable resistor 38 molded therein. A suitable variable resistor is available from Interlink Electronics under the brand name FSR. Other thin film strain gauges are also suitable to function as a variable resistor.

Suitable input lead 40 and output lead 41 extend from the resistor 38 to the exterior of the cover door 30 and are operably connected to an electrical circuit 42 which is in turn operably connected to a horn 44. The electrical circuit is constructed to provide a constant input voltage to input lead 40 and is also constructed to actuate horn 44 upon sensing an appropriate output voltage from the variable resistor 38 in output lead 41.

In operation, an operator merely presses the deformable front wall section 35 when the horn is desired. The pressing of the front wall 35 deforms the wall 35 inwardly and also stress and deforms the force sensitive variable resistor molded therein. The variable resistor electrically reacts to this stress and changes its electrical resistance. The output lead 41 which produced a first non-actuating voltage based upon the constant input voltage on input lead 40 now produces a second actuating voltage which is sensed by the electrical circuit which then actuates horn 44.

Referring now to figure 4, a thin film piezoelectrical device 50 is substituted for the variable resistor. The piezoelectrical device 50 produces a voltage when a mechanical stress or pressure is exerted thereon. Its output lead 51 is operably connected to an electrical circuit 52 that is connected

to horn 44. The electrical circuit 52 senses the produced voltage by the stressed piezoelectrical device to actuate the horn 44.

Both the variable resistor and piezoelectrical device can be positioned at the central axis 19 of the hub 18. Furthermore, instead of being molded into the front wall section 35, they both may be adhered to the inside surface 37 of the wall section 35. As shown in Figures 5 and 6, a thin film transducer member 65, is adhered to inside surface 37. The adhesive used to bond the member 65 to surface 37 may be a urethane moisture cured base or a pressure sensitive adhesive. Standoff protrusion 67 extends rearwardly from the inside surface 37 to protect and space the member 65 from any direct contact with parked material of the air bag 26. The protrusions may extend about $\frac{3}{16}$ inch for a member 65 having $1\frac{1}{2}$ inch sides. The protrusions 67 are preferably located near the corners 69 of the member 65. Other locations such as near the middle of each edge 71 is also suitable. The protrusions can be integrally molded with the front wall section 35. The protrusion can be any cross-sectional shape and may be ridgelike and circumscribe member 65. The member 65 has its output leads 66 operably connected to an electrical circuit (not shown). The member 65 similar to transducers 38 or 50 is sensitive to band pressure applied to the front wall section 35.

Referring now to figure 7, a door cover 55 has a central tear seam 57 with two transducers 58 embedded in a deformable front wall section 59 about each side of the seam 57. The front wall may have sections 61 that can be embossments or recesses or other indication to designate the location of the transducers. The transducers, either a variable resistor or piezoelectrical device, are thin film devices that react to pressure exerted on the sections 61. Each transducer 58 has its output lead 63 operably connected to an electrical circuit (not shown).

Other variations and modification of the invention are possible without departing from its scope and spirit as defined by the appended claims.

Claims

1. In a steering wheel for a motor vehicle including an air bag unit having a gas generator within a casing, an air bag operably fixed to said casing for receiving gas from said gas generator, and a cover door for closing said casing and concealing said air bag; said cover door characterized by:
 - a deformable front wall section that is deformable upon hand pressure;
 - a thin film transducer mounted to the front wall, said transducer normally producing a first

nonactuating output voltage and being subject to the same deformation forces as the deformable front wall section due to hand pressure and being electrically sensitive to said deformation forces to produce a second actuating output voltage; and

said thin film transducer being operably connectable to an electrical circuit that is connected to an electrical device, said electrical device being actuated by said circuit upon said transducer producing said second actuating voltage.

2. In a steering wheel as defined in claim 1 further characterized by:

said electrical device being a horn.

3. In a steering wheel as defined in claim 1 further characterized by:

said transducer being molded within the front deformable wall.

4. In a steering wheel as defined in claim 3 further characterized by:

said transducer being a force sensitive variable resistor which has its resistance change upon pressure exerted on the deformable front wall section thereby producing a different output voltage which via said electrical circuit actuates said electrical device.

5. In a steering wheel as defined in claim 4 further characterized by:

said electrical device being a horn.

6. In a steering wheel as defined in claim 3 further characterized by:

said transducer being a piezoelectrical device which transforms pressure exerted on said deformable front wall section that is transmitted to said piezoelectrical device into an actuating voltage that is transmitted to said electrical circuit.

7. In a steering wheel as defined in claim 6 further characterized by:

said electrical device being a horn.

8. In a steering wheel as defined in claim 1 further characterized by:

said thin film transducer being adhered to an inside surface of a front wall section.

9. In a steering wheel as defined in claim 8 further characterized by:

protrusion means extending rearwardly from the inside surface of the front wall section and located about said thin film transducer for

standing off said air bag from making direct contact with said transducer.

10. In a cover door for an air bag unit for use in a steering wheel of a motor vehicle having an actuating mechanism for an electrical device, said actuating mechanism characterized by:

a deformable front wall section that is deformable upon hand pressure;

a thin film transducer mounted to the front wall, said transducer normally producing a first nonactuating output voltage and being constructed to undergo the same deformation as the deformable front wall section due to hand pressure exerted thereon and being electrically responsive to said deformation to produce a second actuating voltage; and

said thin film transducer being operably connectable to an electrical circuit that is connected to an electrical device, said electrical device being actuated by said circuit upon said transducer producing said second actuating voltage.

11. In a cover door as defined in claim 10 further characterized by:

said electrical device being a horn.

12. In a cover door as defined in claim 10 further characterized by:

said transducer being molded within the front deformable wall.

13. In a cover door as defined in claim 12 further characterized by:

said transducer being a force sensitive variable resistor which has its resistance change upon pressure exerted on the deformable front wall section thereby producing a different output voltage which via said electrical circuit actuates said electrical device.

14. In a cover door as defined in claim 13 further characterized by:

said electrical device being a horn.

15. In a cover door as defined in claim 13 further characterized by:

said transducer being a piezoelectrical device which transforms pressure exerted on said deformable front wall section that is transmitted to said piezoelectrical device into an actuating voltage that is transmitted to said electrical circuit.

16. In a cover door as defined in claim 15 further characterized by:

said electrical device being a horn.

17. In a steering wheel as defined in claim 10 further characterized by:

said thin film transducer being adhered to an inside surface of a front wall section.

18. In a steering wheel as defined in claim 17 further characterized by:

protrusion means extending rearwardly from the inside surface of the front wall section and located about said thin film transducer for standing off said air bag from making direct contact with said transducer.

19. In a steering wheel for a motor vehicle characterized by:

a deformable front wall section that is deformable upon hand pressure;

a thin film transducer mounted to the front wall, said transducer normally producing a first nonactuating output voltage and being constructed to undergo the same deformation as the deformable front wall section due to hand pressure exerted thereon and being electrically responsive to said deformation to produce a second actuating voltage; and

said thin film transducer being operably connectable to an electrical circuit that is connected to an electrical device, said electrical device being actuated by said circuit upon said transducer producing said second actuating voltage.

20. In a steering wheel as defined in claim 19 further characterized by:

said steering wheel having a hub section;

said deformable wall section mounted on said hub section; and

said electrical device being a horn operably connected via an electrical circuit to said transducer.

21. In a steering wheel as defined in claim 20 further characterized by:

said transducer being a force sensitive variable resistor which has its resistance change upon pressure exerted on the deformable front wall section thereby producing a different output voltage which via said electrical circuit actuates said horn.

22. In a steering wheel as defined in claim 20 further characterized by:

said transducer being a piezoelectrical device which transforms pressure exerted on said deformable front wall section that is transmitted to said piezoelectrical device into an actuating voltage that is transmitted to said electrical circuit which actuates said horn.

23. In a steering wheel for a motor vehicle including an air bag unit having a gas generator within a casing, an air bag operably fixed to said casing for receiving gas from said gas generator, and a cover door for closing said casing and concealing said air bag; said cover door characterized by:

a deformable front wall section that is deformable upon hand pressure;

a transducer molded into said front wall section, said transducer normally producing a first nonactuating voltage and being electrically responsive to deformation of said front wall section due to hand pressure to produce a second actuating voltage; and

said transducer being operably connectable to an electrical circuit that is connected to an electrical device, said electrical device being actuated by said circuit upon said transducer producing said second actuating voltage.

24. In a steering wheel for a motor vehicle characterized by:

a deformable wall section that is deformable upon hand pressure;

a transducer molded into said wall section, said transducer normally producing a first nonactuating voltage and being electrically responsive to deformation of said wall section due to hand pressure to produce a second actuating voltage; and

said transducer being operably connectable to an electrical circuit that is connected to an electrical device, said electrical device being actuated by said circuit upon said transducer producing said second actuating voltage.

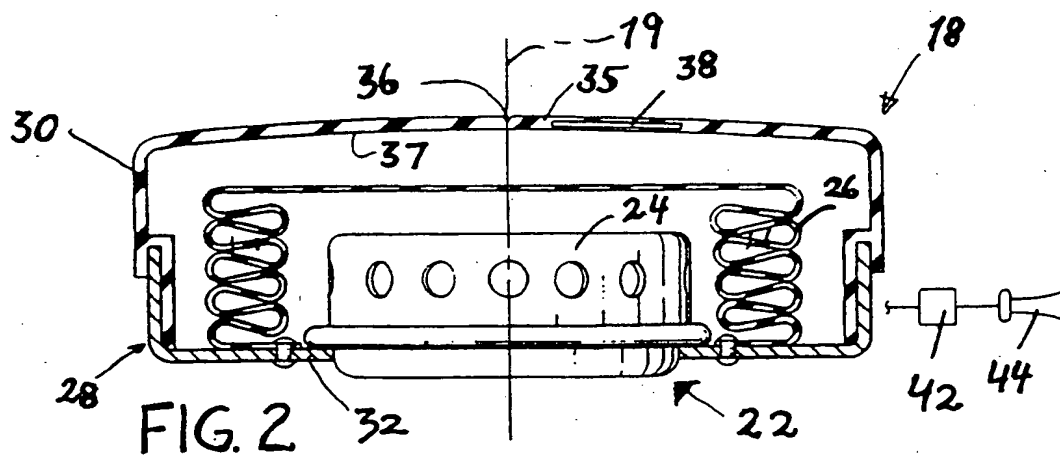
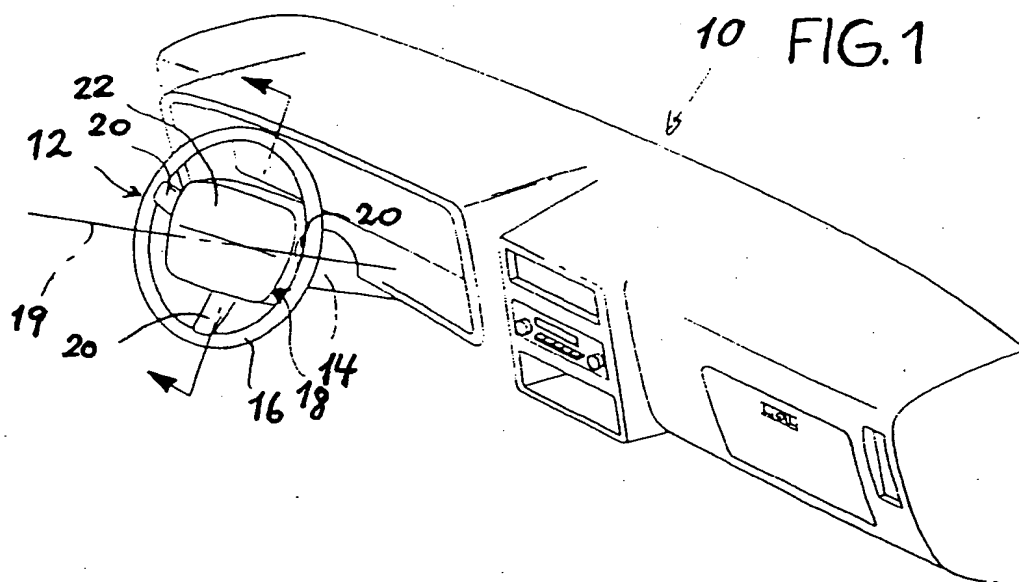


FIG. 3

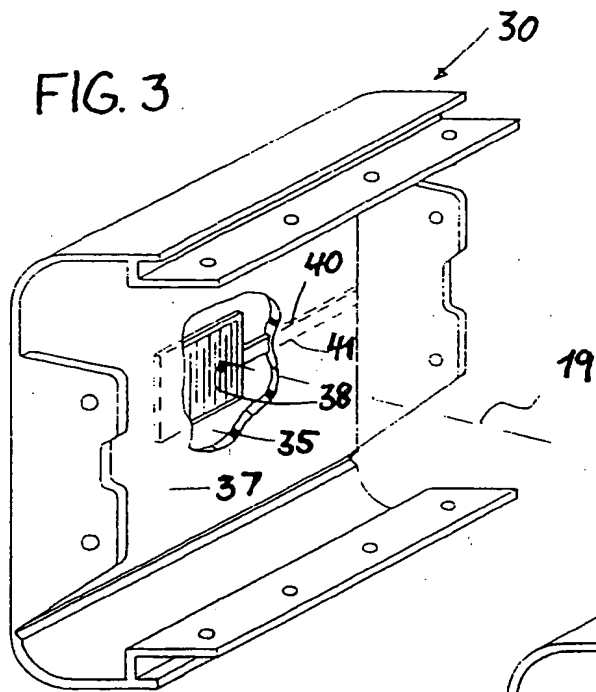


FIG. 4

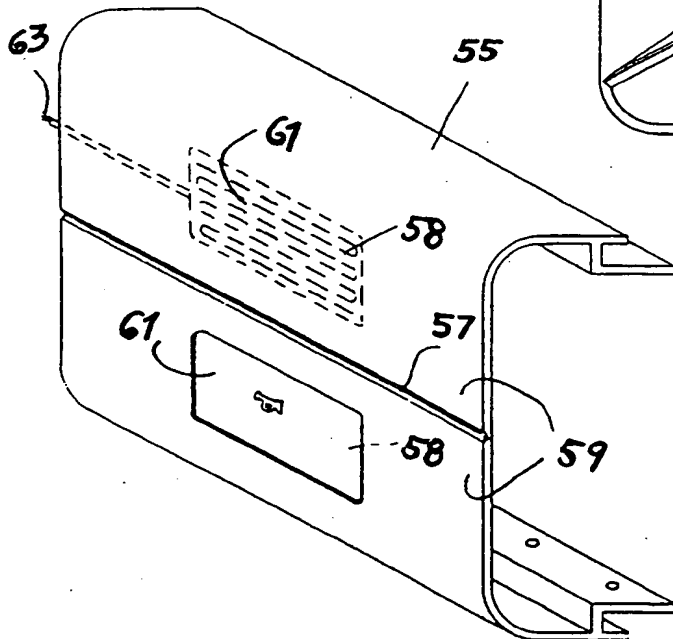
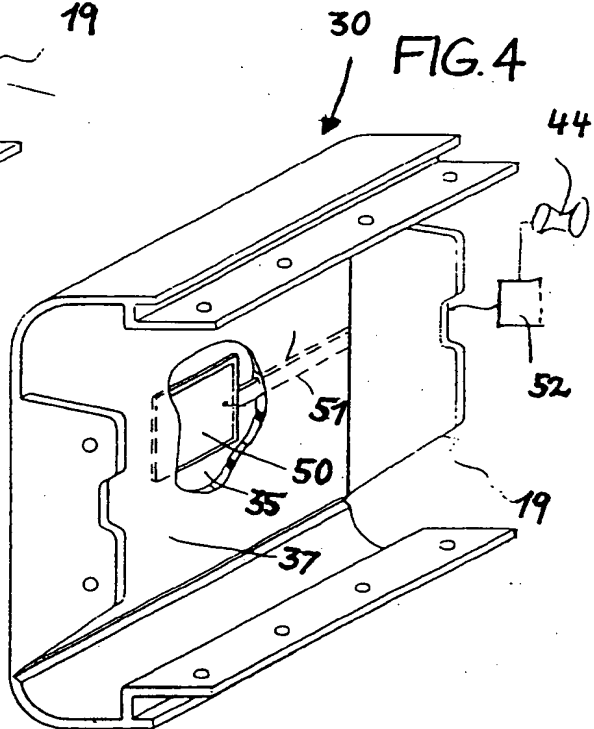
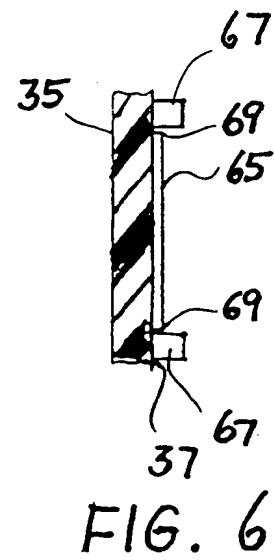
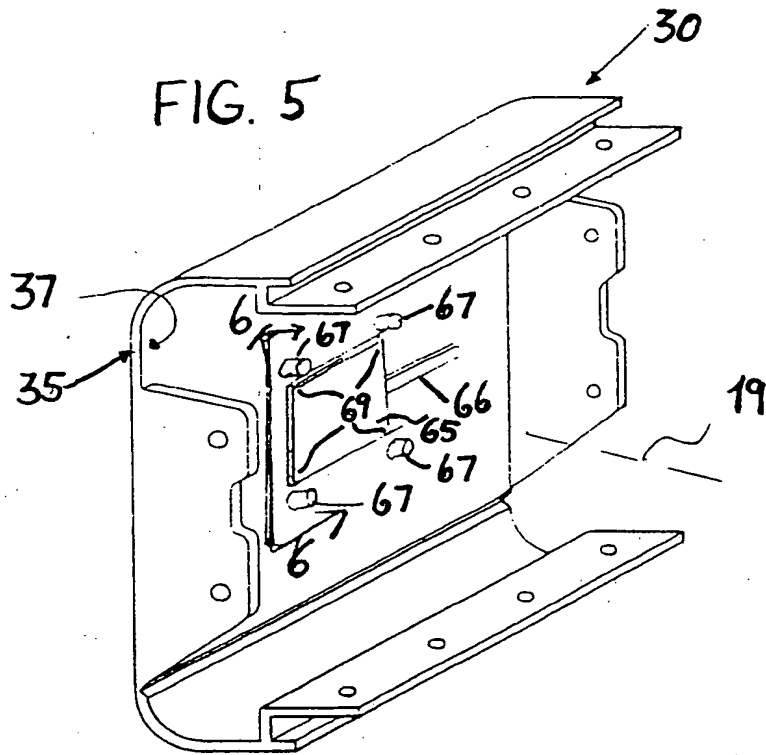


FIG. 7





European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 93 10 0691

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-A-4 016 047 (BAYERN-CHEMIE) * column 1, line 35 - line 47 * * column 2, line 53 - line 67 * * column 2, line 10 - line 18 * * column 4, line 9 - line 42 * ---	1-7, 10-16, 19-24	B60R21/20 B60R16/00
X	DE-A-4 034 539 (TOYODA GOSEI) * column 7, line 9 - column 8, line 4 * ---	1-3, 9-12, 17-20, 23,24	
E	EP-A-0 534 694 (MORTON INTERNATIONAL) * column 5, line 33 - line 40 * ---	1-3, 10-12, 19,20, 23,24	
A	US-A-4 458 173 (KAUFMAN ET AL) * column 1, line 55 - column 2, line 29 * ---	6,7,15, 16,22	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	DE-A-3 233 872 (PEBRA GMBH) * claims 1,2 * -----	4,5,13, 14,21	B60R H03K
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 06 AUGUST 1993	Examiner STANDRING M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			

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